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Descartes
research

Model-based Network Analysis and Optimization

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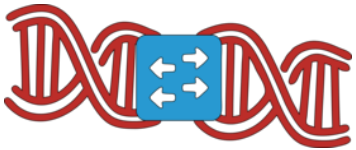
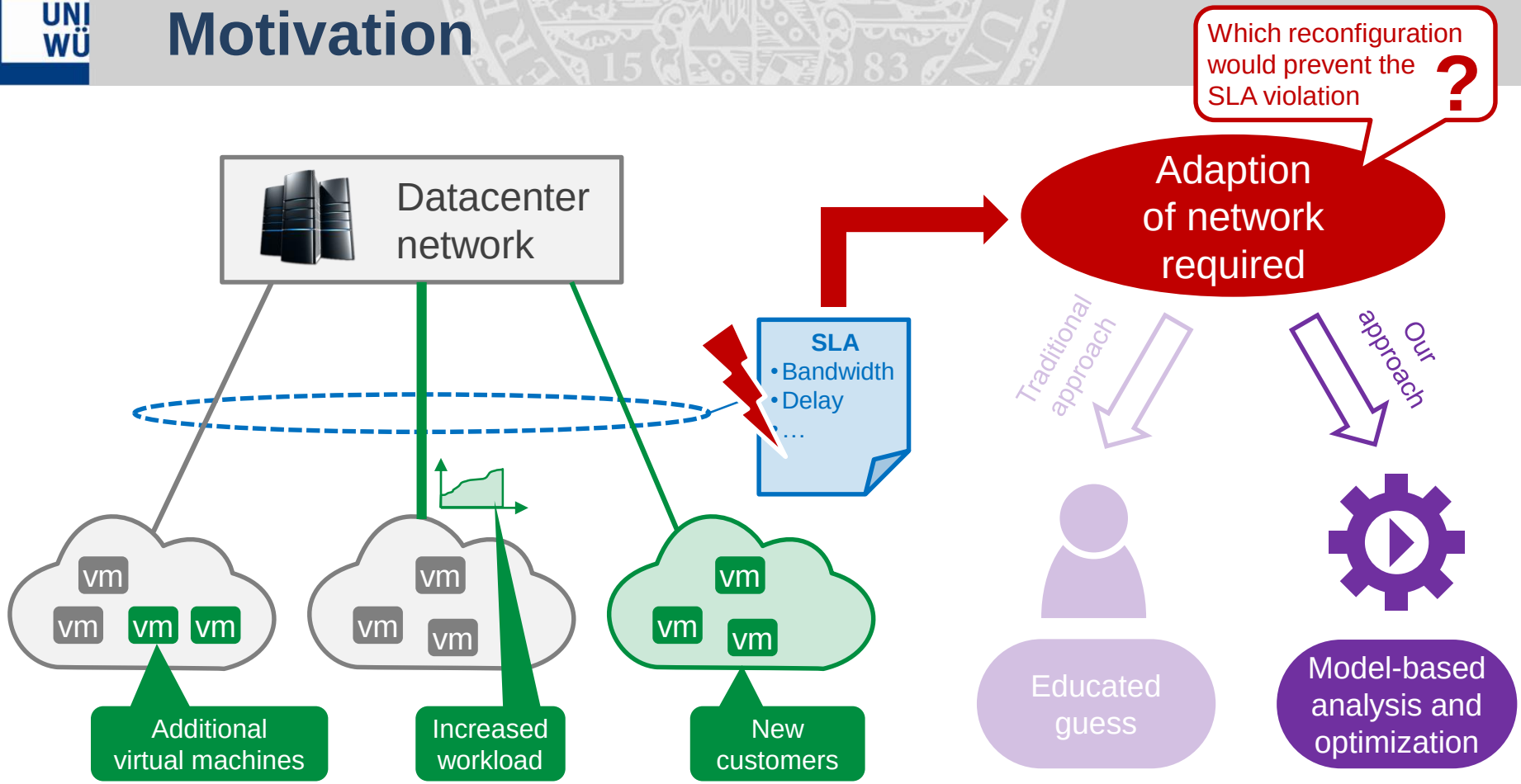
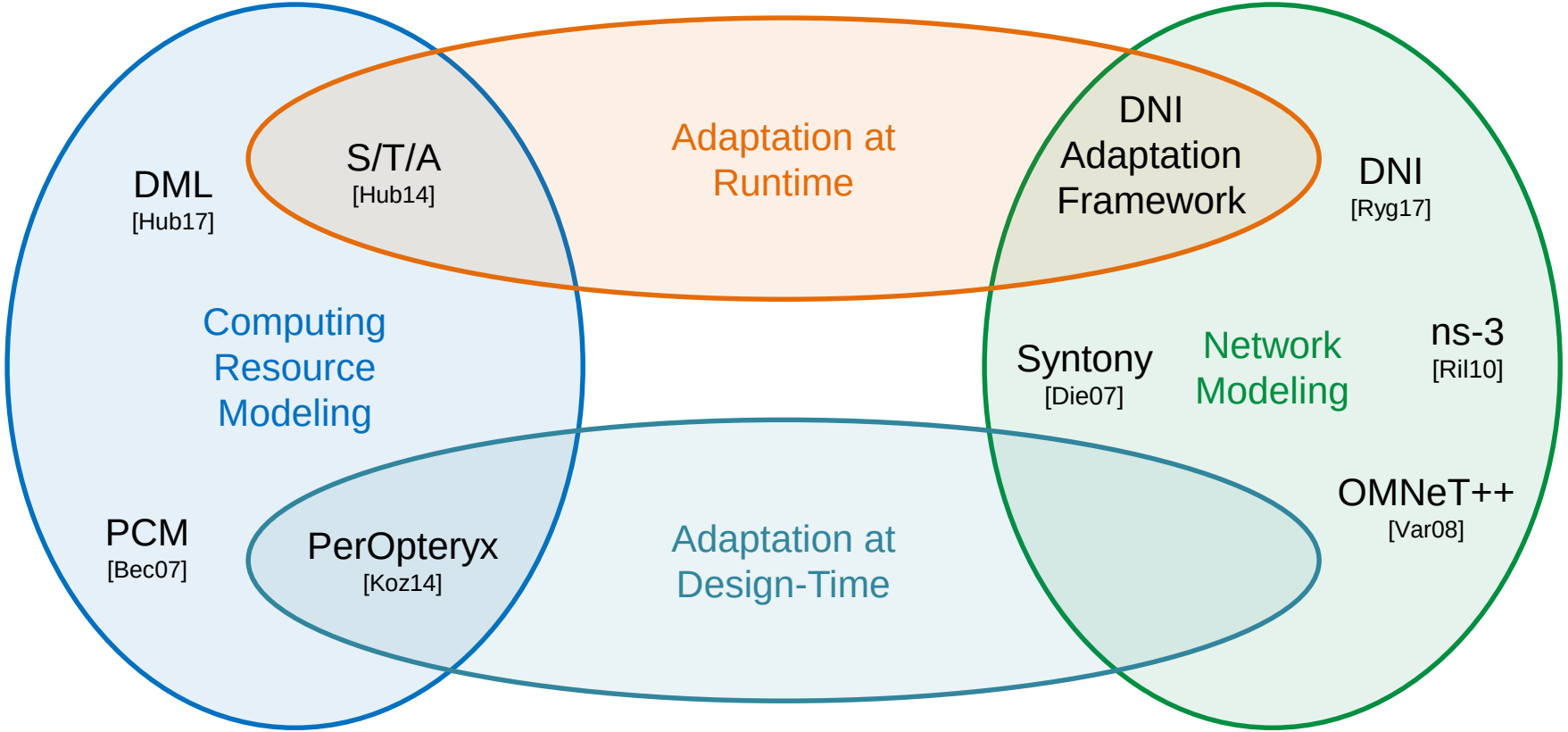


http://descartes.tools/dni

Motivation


Which reconfiguration would prevent the SLA violation ?
Adaption of network required
Traditional approach
Our approach
Datacenter network
SLA
• Bandwidth
• Delay
• …
vm
Additional virtual machines
Increased workload
New customers
Educated guess
Model-based analysis and optimization

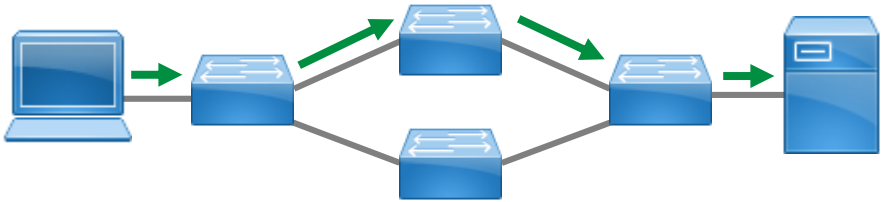
Point of Contribution



Descartes Network Infrastructure Modeling (DNI)

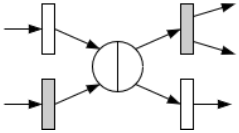
Network Modeling

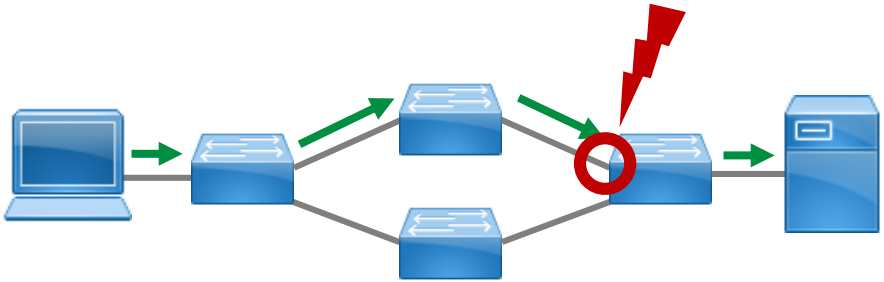
- Structure
- Configuration
- Traffic



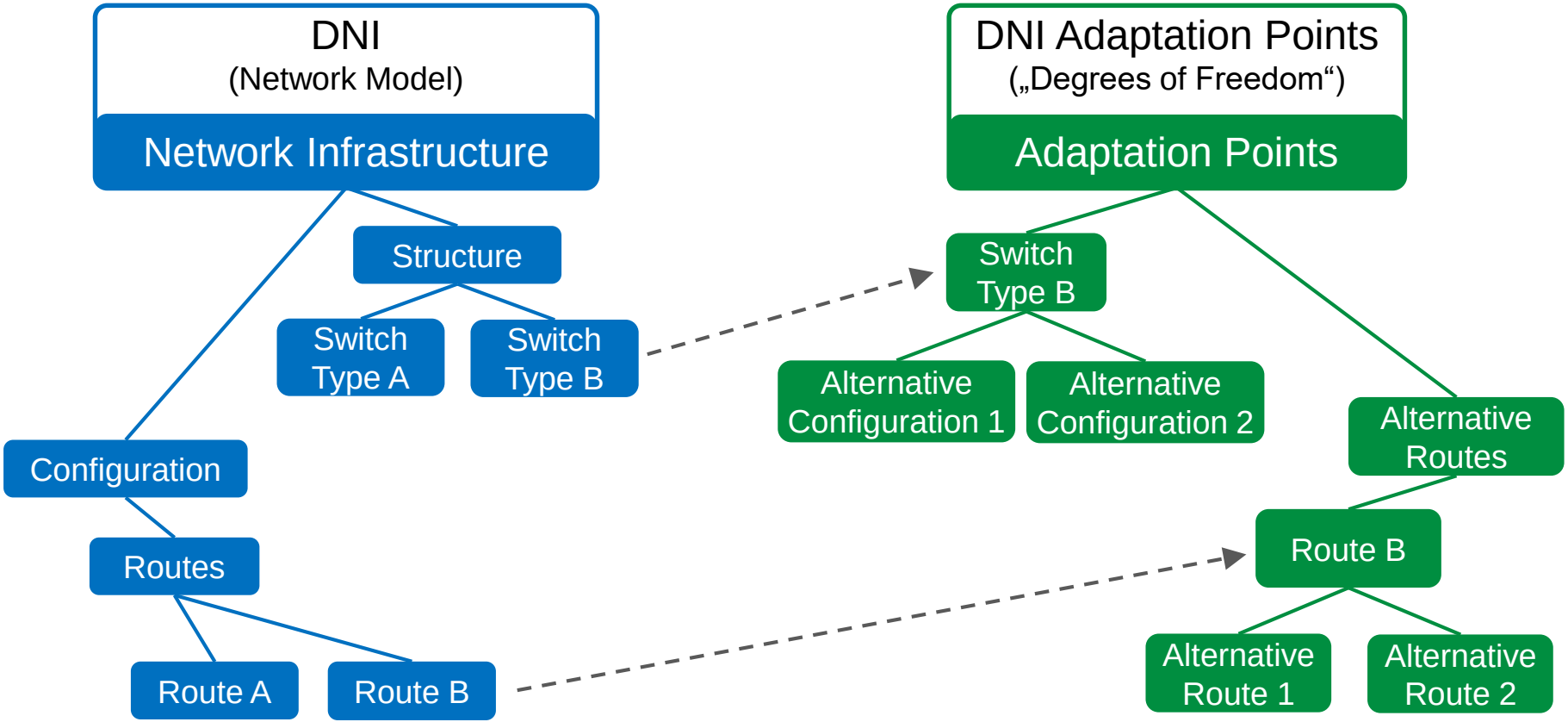
Simulation

- Transformation to Queueing Petri Nets
- Performance evaluation
- Detection of bottlenecks



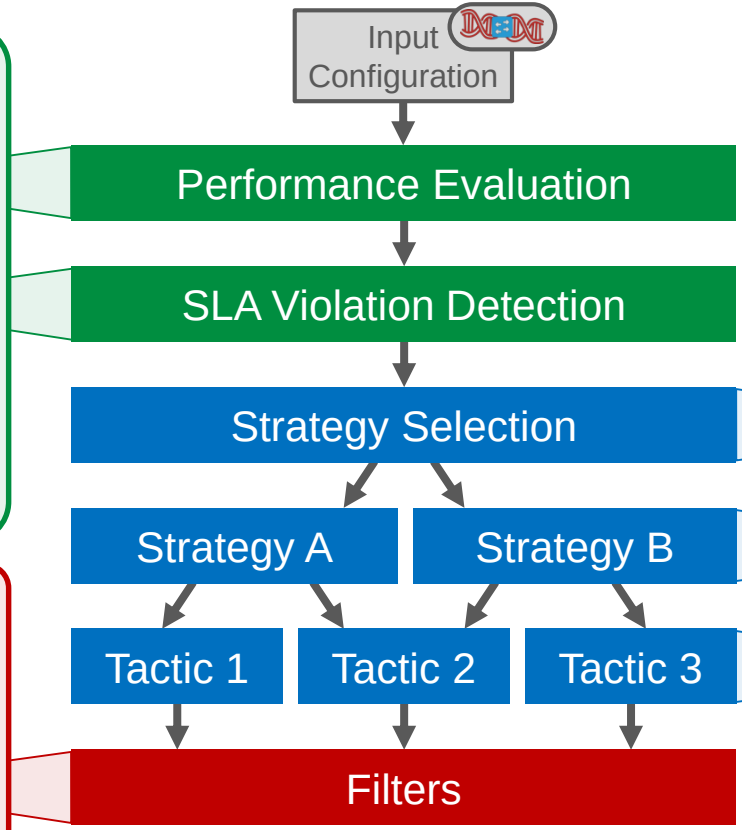


Adaptation Points Model



Adaptation Process

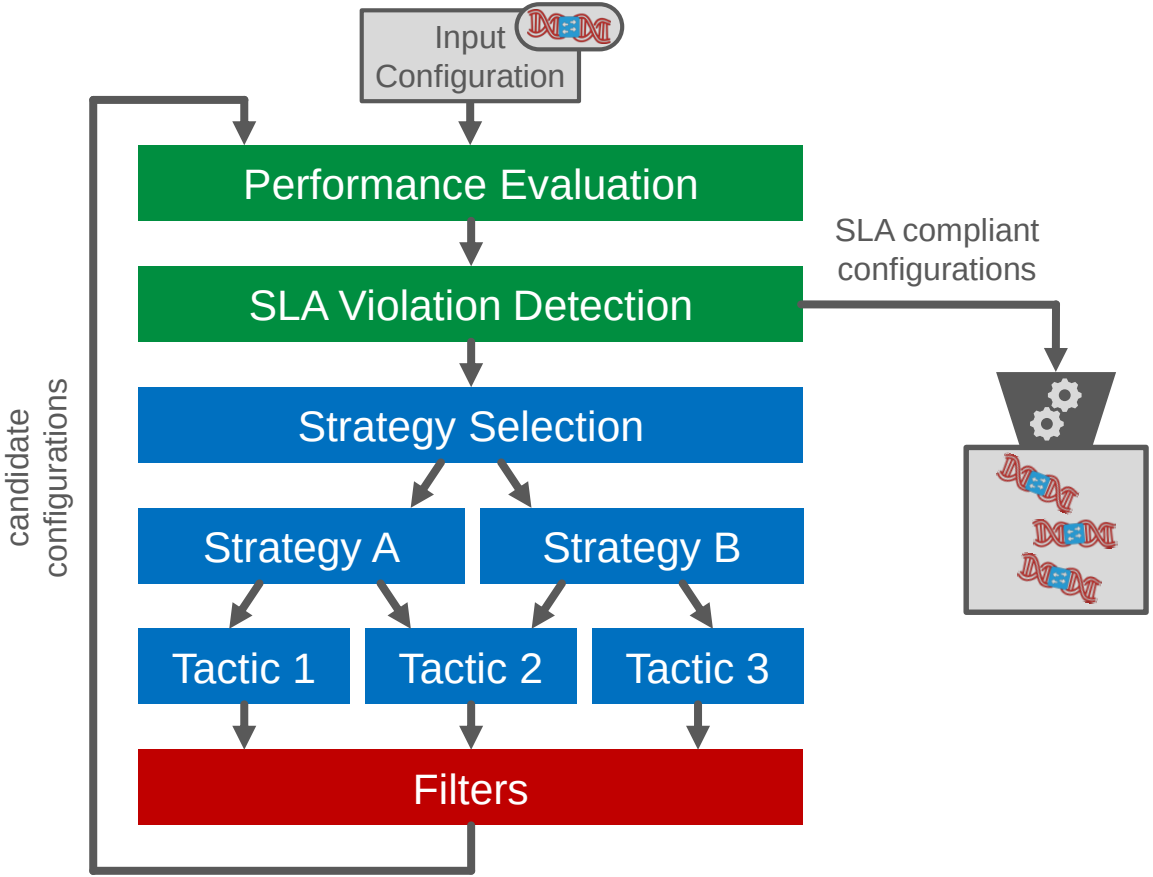
- Running simulation on DNI network model with predefined workload
- Different solvers (SimQPN, OMNeT++, …)
- Simulation returns detailed performance predictions
- Detection of violated SLAs



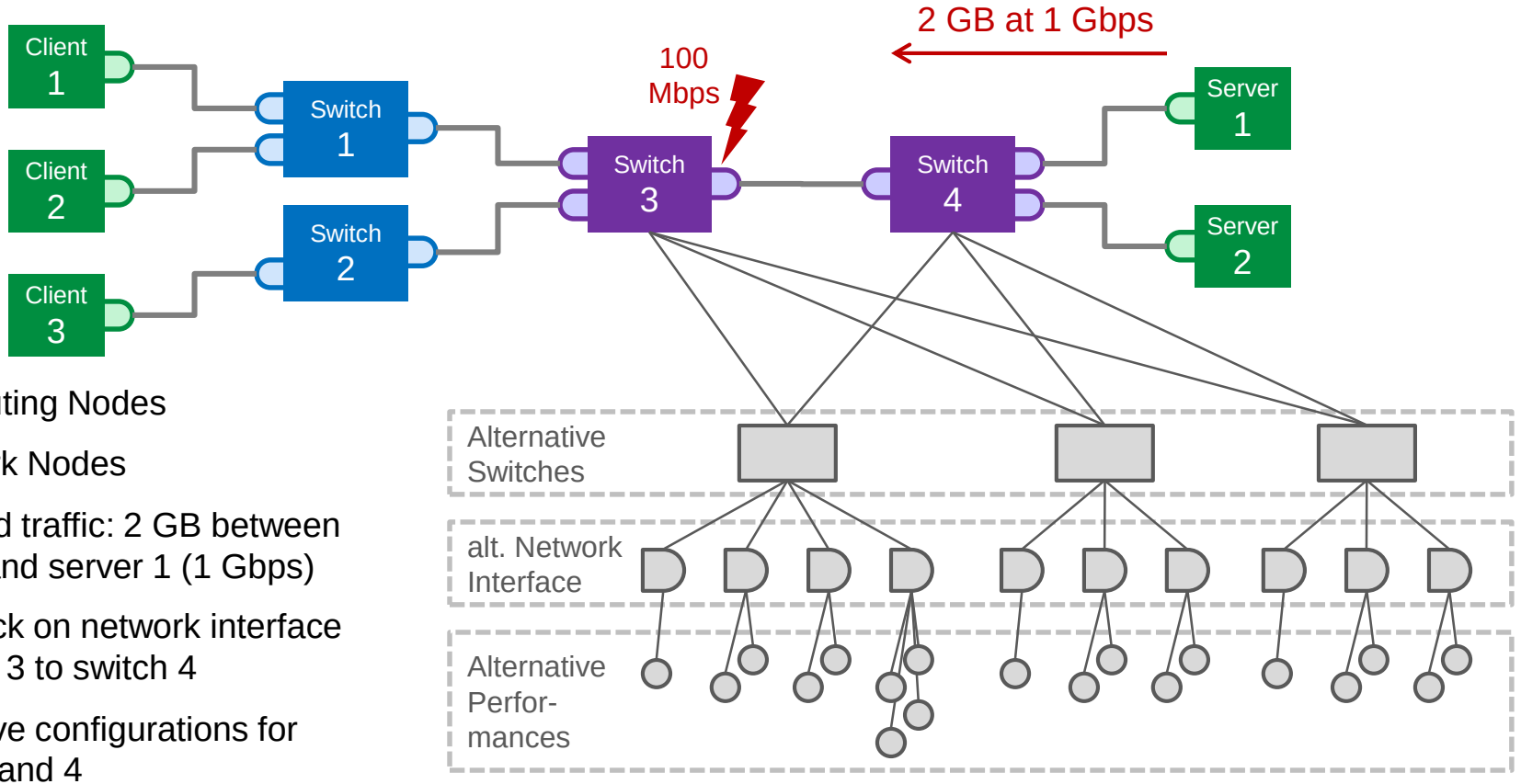
- Selecting strategy based on violated SLAs
- Each strategy could trigger multiple tactics (branching)
- A tactic executes a specific adaptation operation on a type of components
- Multiple solving candidate configurations possible

- Filter generated candidate configurations
- Limits the number of models, which have to be analyzed in next iteration

Adaptation Process

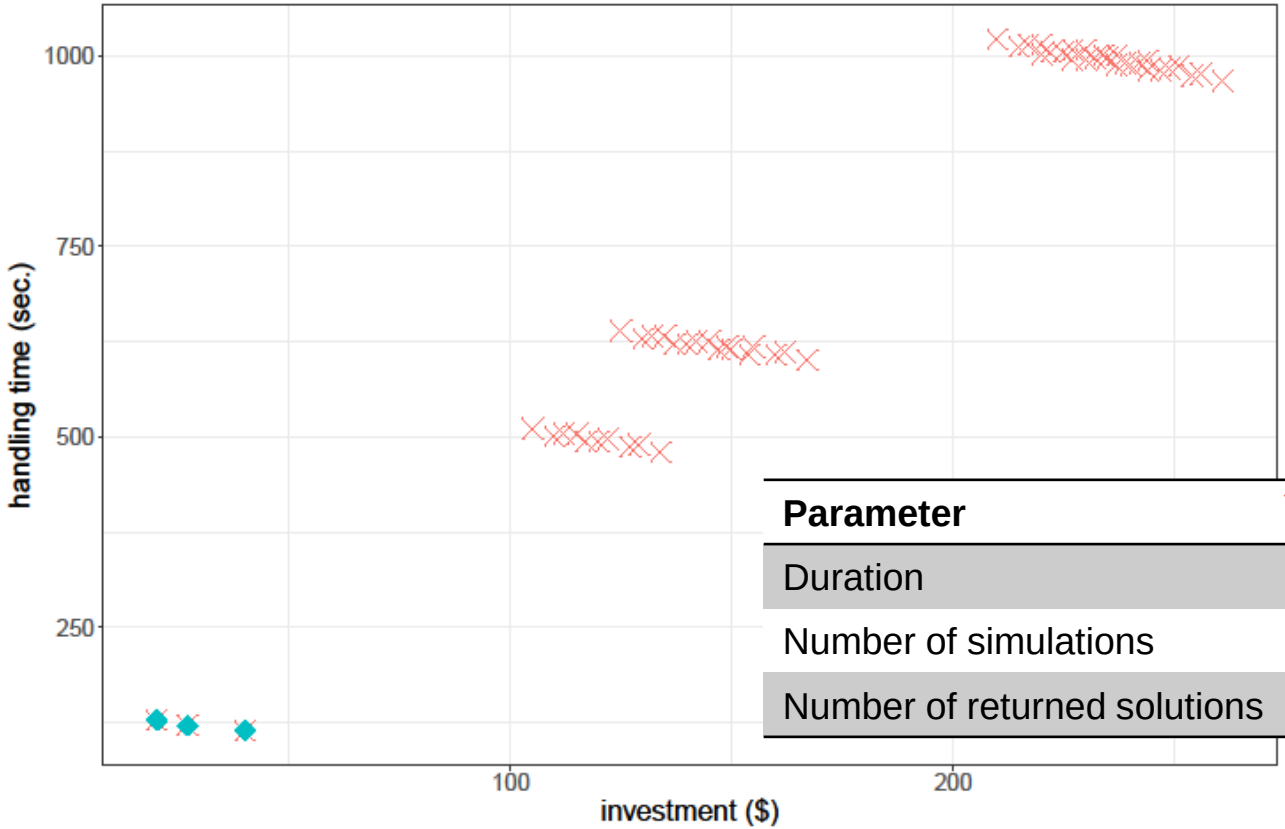


Experimental Optimization Scenario



- 5 Computing Nodes
- 4 Network Nodes
- Observed traffic: 2 GB between client 1 and server 1 (1 Gbps)
- Bottleneck on network interface at switch 3 to switch 4
- Alternative configurations for switch 3 and 4

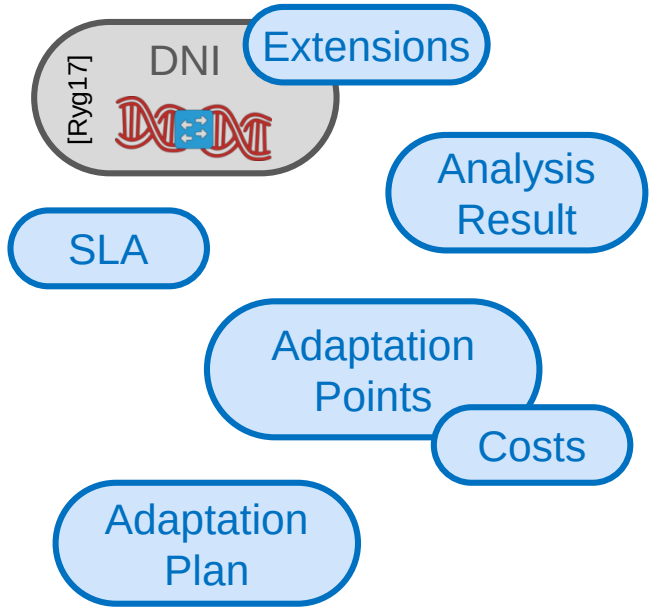
Efficient Pareto Front Discovery



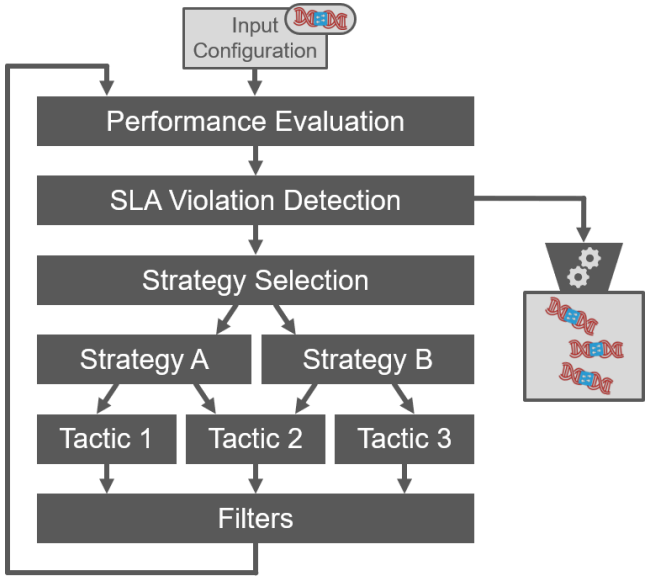
Parameter	Brute Force	Optimized
Duration	1,75 h	24 sec.
Number of simulations	3190	10
Number of returned solutions	231	3

Contributions

Models



Adaptation Process



Adaptation Framework

Conclusion

Benefits

- Model-based detection of SLA violations on networks
- Suggestion of network adaptations
- Efficient Pareto front discovery
- Respects user constraints
- Evaluation of suggested adaptations

Future Work

- Evaluate alternative model solvers
- Support for SDN flows
- Apply at scale

Literature

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Thank You for Your Attention

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